MONTHLY NOTICES

OF THE

ROYAL ASTRONOMICAL SOCIETY.

VOL. XXX. *June* 10, 1870. No. 8.

WILLIAM LASSELL, Esq., President, in the Chair.

John Dickinson, Esq., 11 Upper Grosvenor Street, and Capt. David Smith, Warkworth Terrace, Commercial Road, were balloted for and duly elected Fellows of the Society.

On the Orbit of α Centauri. By E. B. Powell, Esq.

In the notes to my Second Catalogue of Binary Stars published in vol. xxii. of the Society's *Memoirs*, I gave a revised orbit for *α Centauri*, representing the results of observations up to 1862.3; and in a communication dated March 9, 1864, and published in the *Monthly Notice* for May of that year, I invited attention to the important part of the orbit about to be described, viz., the extremity of the perspective ellipse corresponding to the lesser maximum of distance. I have now to state that the comparison has, so to speak, doubled the above extremity, and that consequently the orbit can be determined very approximately. Hitherto it was impossible, as the lamented Captain Jacobs remarked, to say how far the apparent ellipse extended in a northerly direction, and correspondence between observation and calculation did not suffice to establish the correctness of a set of elements. Now, however, though even four or five additional years will enable us to improve the orbit, especially as to the time of periastral passage, the results I have arrived at undoubtedly approximate *pretty closely* to the truth. These results are as follows:—

Perspective Orbit.

Semi-axis major	17″
Semi-axis minor	2″·8
Greater maximum distance	23″·8
Position angle for ditto	210° 40′
Lesser maximum distance	10″·4
Position angle for ditto	18° 45′
Greater minimum distance	3″·98
Position angle for ditto	301° 45′
Lesser minimum distance	1″·16
Position angle for ditto	115° 30′

Real Orbit.

π	38° 40′
e	·63944
Ω	24° 18′
γ	81° 13′
a	20″·13
P	76·25 years
τ	1874·2

Without going into the details of my late observations, which will find place in a paper I shall do myself the pleasure of laying before the Society hereafter, I may mention that the position of *α Centauri* in the beginning of the year was as given below:—

Angle.	Distance.	Epoch.
20° 27′	10″·24	1870·1

The angle is the mean of 100 observations on thirteen nights; the distance, that of 162 observations on twelve nights. I feel great confidence in both measures.

I have to remark that, in the earlier orbits of *α Centauri* calculated by me, I was misled by a belief that Feuillée's observation was taken after periastral passage. Of late years it has become evident that the observation was taken before that passage. If the above mathematician's record can be fully relied on, as I imagine to be the case, it at once limits the periodic time to something less than 76·6 years. Feuillée remarks that, when he observed the star at Lima on July 4, 1709, the companion was west of the primary; but, about 1862·7, the companion crossed the meridian passing through the primary; consequently 1862·7–1709·5, or 2 (76·6) years, must be somewhat more than twice the period of *α Centauri*.

Madras,
April 20th, 1870.

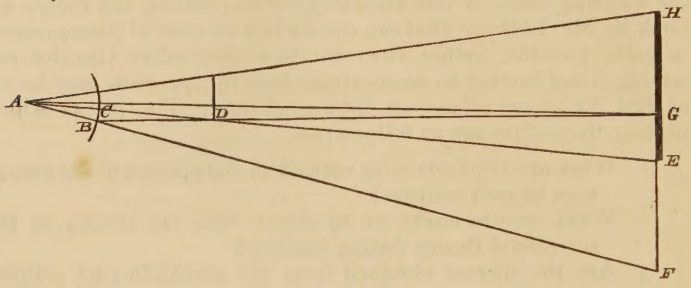
On the Determination whether the Corona is a Solar or Terrestrial Phenomenon. By George M. Seabroke, Esq.

It is my intention in this paper to attempt to show that, with the existing state of our knowledge of the corona, the theory set forth by Mr. Lockyer, that the corona is a terrestrial phenomenon, is quite possible, rather than to show that other theories are wrong,—and further to demonstrate how the question may be set at rest by observations on future eclipses. The points which present themselves are as follows:—

1. What are the facts with respect to the spectra of the corona seen in past eclipses?
2. What spectra ought we to obtain from the corona on the terrestrial theory during totality?
3. Are the spectra obtained from the corona in past eclipses reconcilable to those we ought to get on the above hypothesis?
4. What spectrum ought we to get from the corona after totality?
5. What spectrum ought we to get before totality on the following side of the Moon?
6. What difference will there be between the spectrum of the central portions of the corona and that of the distant parts during totality?

With regard to (1) during the Indian eclipse, Major Tennant writes,—"Directly I saw the whole Moon in the finder I set the cross-wires immediately outside its upper limb. By the time I got to the spectroscope the cloudy range seen in the photographs had vanished from the slit, and I saw a faint *continuous* spectrum. Thinking that want of light prevented my seeing the bright lines which I had fully expected to see in the lower strata of the corona, I opened the jaws of the slit and repeatedly adjusted by the finder, but without effect. *What I saw was undoubtedly a continuous spectrum, and I saw no bright lines.* There may have been dark lines of course, but with so faint a spectrum, and the jaws of the slit wide apart, they might escape notice." With respect to the American eclipse, Prof. Pickering, with an ordinary chemical spectroscope directed to the Sun's place during totality, saw a continuous spectrum with two or three bright lines; one "near E" and a second "near C." Prof. Young, while examining a part of the prominence at $+146°$, saw C, near D, a line at 1250 ± 20, and another at 1350 ± 20, and the 1474 K line very bright, but not equal to C and D_3; but he observed that the 1474 K line, unlike C and D_3, extended across the spectrum; and, on moving the slit away from the prominence, it persisted, while D_3 disappeared. He also believes that the two faint lines between it and D_3 behaved in like manner. On examining a prominence on the other side of the Sun, he observed nine lines and a faint continuous spectrum without any traces of dark lines in it.

As to the second point, let us find what spectrum we ought to obtain from a corona at a point on the Earth where the limbs of the Sun and Moon are in line; that is, where the eclipse is total, exactly.



Let A be a point on the Earth where Sun is eclipsed;
B C, limits of Earth's atmosphere;
D, the Moon;
H E, Photosphere of Sun;
E F, the apparent Corona.

Now, if the corona be terrestrial, the light producing it must be reflected or separated from the atmosphere within the triangle A B C.

Join B D and produce to G.

Then G is the most distant point from the limb on the Sun's disk, from which light is reflected to A by the atmosphere; and if the triangle E A F or angular extent of the corona from the Sun is given, we can find $\angle$ E A G.

The angles being small, $\frac{\angle \text{EAG}}{\angle \text{EAF}} = \frac{\text{GE}}{\text{EF}}$, approximately.

$$\text{GE} : \text{CB} :: \text{ED} : \text{DC}, \text{ therefore } \text{GE} = \text{CB}\,\frac{\text{ED}}{\text{DC}}, \qquad (1)$$

$$\text{and} \quad \text{EF} : \text{CB} :: \text{EA} : \text{CA}, \text{ therefore } \text{EF} = \text{CB}\,\frac{\text{EA}}{\text{CA}}, \qquad (2)$$

and $\text{ED} = \text{EA} - \text{AD}$, and AD being small in proportion to E A, E D may without great error be taken as equal to E A.

Dividing (1) by (2),

$$\frac{\text{GE}}{\text{EF}} = \frac{\frac{\text{ED or EA}}{\text{DE}}}{\frac{\text{EA}}{\text{CA}}} = \frac{\text{CA}}{\text{DC}} = \frac{\text{Height of atmosphere}}{\text{Dist. of Moon} - \text{height of atmosphere}'}$$

$$\therefore \frac{\angle \text{EAG}}{\angle \text{EAF}} = \frac{\text{Height of atmosphere}}{\text{Dist. of Moon} - \text{height of atmosphere}'}$$

$$\text{EAG} = \text{EAF} \frac{\text{Height of atmosphere}}{\text{Dist. of Moon} - \text{height of atmosphere}}.$$

If, for example, we now take

$$\text{EAF} = 30',$$

and Height of atmosphere = 100 miles,

and Dist. of Moon — ht. of atmosphere = 240,000 miles,

then $\angle \text{EAG} = 30' \frac{100}{240{,}000} = 0''{\cdot}75.$

Therefore, the only part of the photosphere available in this case for illuminating the atmosphere is a ring of photosphere $0''{\cdot}75$ in width, and from the figure it will be seen that only that part of the corona most distant from the centre (as at B) will receive even the whole of this light; and it is manifest from the figure that the nearer any part of the corona is to the centre (nearer C) the less light will it receive from the photosphere, so that the mean illumination of the corona by the photosphere is only equal to that which would be given by a ring $\frac{1}{2} \times 0''{\cdot}75 = 0''{\cdot}375$ wide.

Now, since the chromosphere extends from E towards F, the whole of the atmosphere producing the corona is illuminated equally by the chromosphere, and since the mean height of the chromosphere is much more than $0''{\cdot}375$, or other height deduced from the foregoing formula, it is quite possible that the dark lines of the spectrum coming from so small an area of photosphere may be blotted out, as Mr. Lockyer observes, by the light from a greater area of chromosphere wherever the chromosphere contains the proper substances; and it is probable that the vapours of a number of substances from the photosphere are carried up into the chromosphere in small quantities sufficient to obliterate the dark lines, since we find the vapours of magnesium, sodium, barium, and iron, sometimes in the chromosphere.

Although the total amount of light of all kinds given by an equal area of chromosphere is small compared to that given by an equal area of photosphere, still each particular kind of light from the chromosphere is as intense, or nearly so, as that particular kind of light from the photosphere, so that, if equal areas of chromosphere and photosphere be illuminating a part of our atmosphere, that part would give a spectrum, having its dark lines erased by the chromosphere, or a continuous spectrum. When the area of the photosphere is much less than that of the chromosphere, the bright lines given by the chromosphere would be much more visible than the remaining dark lines of the photospheric spectrum.

From this it appears that during totality we ought to get from the corona a nearly continuous spectrum, with bright lines given by the substances in the chromosphere. Some of the dark lines

of the photospheric spectrum ought to remain where the chromosphere does not contain substances giving bright lines in their place. Where the illuminating areas of the photosphere and chromosphere are equal, which is possible where the chromosphere is unusually low, we ought to obtain a spectrum as above, but without bright lines, the chromospheric lines being then only just able to obliterate the dark ones.

3. In the Indian eclipse Major Tennant saw a continuous spectrum without bright lines, which is that we should obtain on the above hypothesis, when the areas of chromosphere and photosphere illuminating our atmosphere are equal; but it is shown above that during totality with the ordinary height of chromosphere the illuminating area of chromosphere is much greater than that of the photosphere, so that the part of the chromosphere illuminating that part of the corona under examination must have been unusually low, or, as was probably the case, there were bright lines, for, as he says the spectrum was very faint, they may have been missed. There ought on this hypothesis to have been dark lines, but Major Tennant says that with so wide a slit he might have missed them. Prof. Pickering saw a continuous spectrum with bright lines, which is what we ought to obtain when the atmosphere is illuminated by a greater area of chromosphere than photosphere, as has been shown to be the case when the chromosphere is at its normal height. The dark lines which ought to have been visible on Mr. Lockyer's theory might possibly have been too faint to be noticed, since, as stated above, the area of photosphere in this case would be small in proportion to that of the chromosphere, so that the bright lines would appear very plainly when the photospheric spectrum was too faint to render the dark lines visible. As to the 1474 K line observed by Prof. Young to extend across the spectrum beyond the other lines of the chromosphere, Mr. Lockyer observes that he often sees this line and often does not, which appears fatal to this being a real corona line, as, if so, it ought always to be visible. Prof. Young also seems, in the note to his observations, to be doubtful how far this line extended from the prominence; and it is very probable that this line is either iron or hydrogen. There seems to be no evidence that the other lines seen in the corona spectrum are not chromospheric lines.

4. With regard to this point, an inspection of the figure will show that, as the Moon passes over the Sun, more photospheric light becomes available for illuminating the corona; but so long as the available area of the photosphere is less than that of the chromosphere, the dark lines of the spectrum, due to the photosphere, will be erased by the chromospheric lines (wherever the chromosphere contains the proper substances), and as the Moon moves forward the spectrum should on this hypothesis change, and when the illuminating area of the photosphere becomes greater than the area of the chromosphere, the dark lines of the photospheric spectrum should appear. It will also be seen that the

larger the illuminating area of the photosphere becomes the smaller will be the difference between the spectrum of the interior part of the corona and that of the exterior part, since, whatever be the extent of the illuminating surface of the photosphere, the exterior parts of the corona will only receive an excess of light over that received by the interior part equal to the amount of photospheric light received by those parts during totality, or, as in the case above taken, the excess will be equal to that given by a ring of light from the photosphere 0″·75 wide (or G E in the figure), so that, when a few seconds of photosphere are visible to the observer, the difference between the spectra of the exterior and interior parts of the corona would be inappreciable.

5. What spectrum ought the corona to give before totality on the following side of the Moon? In this case, when the angular distance of the limits of the Sun and Moon is some seconds, the difference between the spectra of the exterior and interior parts of the corona is small, since no part of the atmosphere in this case will be illuminated by the photosphere, so we ought to obtain a chromospheric spectrum, together with a faint photospheric one caused by a small amount of photospheric light reflected from the photosphere by the chromosphere.

6. On the foregoing hypothesis during totality the parts of the corona nearest the centre should give a different spectrum to the more distant portions, since the portions nearer the centre receive less photospheric light than the more distant parts, and the same amount of light from the chromosphere.

In order to test the correctness of this theory, advantage may be taken of the following facts:—1st. At that period of the eclipse when the limb of the Sun and Moon are in line with the observer, there will be a difference between the central and distant parts of the corona, and this difference will decrease as the Moon passes on, whereas, by the other theory, there should be the same difference as long as the corona is visible. 2d. If the corona be terrestrial, the spectrum of any portion of it ought to be continually changing during the passage of the Moon; but, if solar, the spectrum should remain unchanged.

On the Displacement of the Bright Lines in the Spectrum of the Solar Chromosphere. By G. M. Seabroke, Esq.

The author in reference to a letter of Father Secchi to the Academy of Sciences of 25th April, writes,—

"For some time past, Mr. Lockyer has been kind enough to allow me the use of his telescope and spectroscope to prepare myself for the observations I intend making during the ensuing eclipse; and as I have been using the same spectroscope with which the discoveries in question have been made, and which have been contested by Father Secchi, I think it right to add my independent testimony on that point."

He remarks that the displacement of the bright lines of the spectrum of the chromosphere cannot be explained in the manner attempted by Father Secchi, by the rotation of the Sun, whatever the velocity of rotation is assumed to be. "For I have frequently seen a change of wave length in the same direction in the spectrum of prominences on opposite sides of the Sun, and if the change was produced by the Sun's rotation the change must be in opposite directions, since one side is approaching and the other receding from us. I also frequently see a change of wave length in the spectrum of one part of a prominence and not in another. How does Father Secchi's theory account for this? Besides, on his hypothesis, the bright lines of the prominences should never appear curved as I often see them, but should remain perfectly straight. The black lines should, on his hypothesis, be also displaced like the bright ones, so that the bright lines would still retain their position with respect to their corresponding black line, whatever be the velocity. Perhaps every one in eight of the prominences I have seen,—and I see two or three every time I looked at the Sun,—have given decided changes of wave length; in fact, the occurrence is so frequent, that unless any extraordinary change is seen, I make no note of it, and the changes of wave length are continually varying, and seldom last more than a quarter to half an hour, which clearly shows that the Sun's rotation has nothing to do with. That there are tremendous movements in the chromosphere is certain, from (1) the alteration of wave length observed in the space of a few minutes or sometimes seconds; (2) when a prominence is observed with a wide slit a change of form can generally be detected in a few minutes;" and he annexes rough sketches of the F line of two prominences showing change of wave length.

London,
June 1, 1860.

On a Spectroscope in which the Prisms are automatically adjusted to the minimum angle of deviation for the particular Ray under examination. By J. Browning, Esq.

In an ordinary spectroscope the prisms are usually adjusted to the minimum angle of deviation for the most luminous rays in the spectrum,—by preference I adjust them myself for the ray E in the solar spectrum. This being done, the prisms are screwed, or otherwise firmly clamped, to the main plate of the spectroscope. Thus adjusted they are liable to two sources of error, one of which places the observer at a serious disadvantage. First, only the particular ray for which the prisms have been adjusted, is seen under the most favourable circumstances, for only this ray passes, as all should do, through the train of prisms parallel to the base of each prism. Of more importance than this, however, is the

fact that the last prism of the train being fixed while the telescope through which the spectrum is viewed is moveable around an arc, it is only when the central portion of the spectrum is being examined, that the whole field of the object-glass is filled. By means of the models, as well as the instrument, which is before you, I hope to make myself clear on this point.

In figure 1, P P &c., represent a train of prisms adjusted as I have just described for the central portion of the spectrum, and screwed firmly in their places. T represents a telescope moving round a centre situated at K. In the position in which

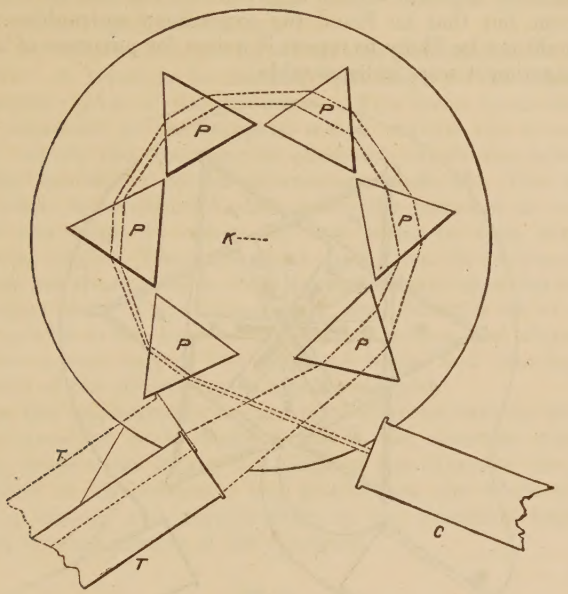


Fig. 1.

the telescope is placed, the whole field of the object-glass would be filled with the green light of the spectrum issuing from the last prism ; but when the telescope is removed to the position shown by the dotted lines, either nearer to R or to V (in which case the red end or the violet end of the spectrum would be in the field of view), then, as you will see by the lines, only a small portion of the spectrum would fall on the object-glass. But it is obvious that owing to the deficiency in light at the extreme ends of the spectrum, it is just in these very positions that it is desirable that the whole field of the object-glass should be filled. Now this can only be effected when the prisms are adjusted to the minimum angle of deviation for the particular portion which is being examined of the spectrum ; and this it will be if the adjustment I have spoken of has been correctly made. This

difference in adjustment is much more than is generally supposed, varying, in accordance with the refractive index of the glass employed, between 10° and 20° for the extreme portions of the spectrum.

Bunsen and Kirchoff, when making their celebrated map of the solar spectrum, adjusted the prisms they used (four in number) for the principal Fraunhofer lines ; but the trouble of doing this is so great that few observers have ever seen the extreme portions of the solar spectrum under favourable circumstances.

A distinguished professor of natural philosophy informs me that he once adjusted a train of prisms for the line H in the solar spectrum, but that he found the experiment so troublesome that he should not be likely to repeat it unless for purposes of accurate investigation it were indispensable.

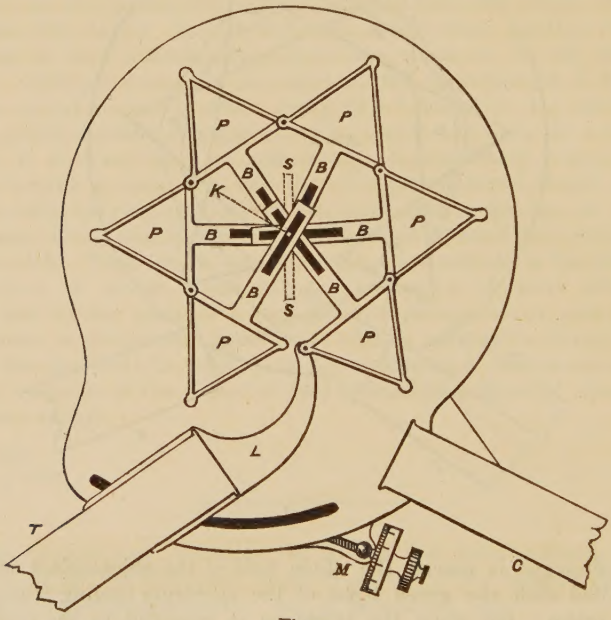


Fig. 2.

Diagram 2 shows the method in which the change in the adjustment of the prisms to the minimum angle of deviation for each particular ray is made automatically. In this diagram, P P &c., as before, represent prisms. All these prisms, with the exception of the first, are unattached to the plate on which they stand. The triangular stands on which the prisms rest are hinged together at the angles corresponding to those at the bases of the prisms. To each of these bases is attached a bar, B, perpendicular to the base of the prism. As all these bars are slotted and run on a common centre, the prisms are brought into

a circle. This central pivot is attached to a dovetailed piece of two or three inches in length, placed on the under side of the main plate of the spectroscope, which is slotted to allow it to pass through. On moving the central pivot the whole of the prisms are moved, each to a different amount in proportion to its distance in the train from the first or fixed prism, on which the light from the slit falls after passing through the collimator, C. Thus, supposing the first prism of the train of C, represented in the diagram, to be stationary, and the second prism to have been moved through 1° by this arrangement; then the third prism will have been moved through 2°, the fourth through 3°, the fifth through 4°, and the sixth through 5°.

Now for the contrivance by which this arrangement is made automatic. A lever, L, is attached by a hinge to the corner of the triangular plate of the last prism. This lever, by its further end, is attached to the support which carries the telescope, through which the spectrum is observed. Both the telescope and lever are driven by the micrometer-screw, M. The action of the lever is so adjusted that, when the telescope is moved through any angle it causes the last prism to turn through double that angle. The rays which issue from the centre of the last prism are thus made to fall perpendicularly upon the centre of the object-glass of the telescope, T, and thus the ray of light travels parallel to the bases of the several prisms, and ultimately along the optical axis of the telescope itself, and thereby the whole field of the object-glass is filled with light.

Thus the apparatus is so arranged that on turning the micrometer-screw, so as to make a line in the spectrum coincide with the cross-wires in the eye-piece of the telescope, the lever L, attached to the telescope and prisms, sets the whole of the prisms in motion, and adjusts them to the minimum angle of deviation for that portion of the spectrum.

Fig. 3.

Fig. 4.

Diagrams 3 and 4 represent the appearances presented when looking through the telescope from which the glasses have been removed. In diagram 3 it will be seen that the whole circle of the object-glass is filled with light, as I have just described, is the case with the new arrangement; while diagram 4 shows the

effect of moving the telescope through the angle in front of the fixed prism.

About three years ago I showed a rough model of the plan I have now described, to Mr. Gassiot, for whom I made the large instrument which was some time in use at the Kew Observatory. Mr. Gassiot immediately asked me if I would apply this arrangement to his large spectroscope. As I did not at that time see my way to make it self-acting by connecting the prisms with the micrometer-screw, I did not feel impelled to carry out the matter at once, owing to the fact that about this time the mapping of the solar spectrum with the large spectroscope in question was discontinued. I also felt that, with that munificent liberality for which Mr. Gassiot has distinguished himself, he had simply asked me to add this contrivance to his large and costly instrument in the interest of science generally, and not with any view to its immediate use.* Since this time, and particularly while I was constructing his solar spectroscope, Mr. Norman Lockyer has repeatedly urged upon me the desirability of completing the arrangement; and from the manner in which it has been received by the distinguished scientific men who have done me the honour to examine it minutely, I am induced to hope that its application will tend to facilitate further researches in spectrum analysis.

Note on the Alteration in the Colour of the Belts of Jupiter.

By John Browning, Esq.

In the Report of the Astronomer Royal to the Board of Visitors, there is the following remark:—

"There has been little opportunity of employing the instrument on other objects, except in a drawing of *Jupiter* by Mr. Carpenter.

"The comparison of this with drawings made eight or nine years ago appears to negative the idea of any change in the colour of *Jupiter's* belts."

With all possible deference to the Astronomer Royal and Mr. Carpenter, I beg to submit that a comparison of drawings made either this year or last year with others made eight or nine years ago, might not throw any light on this question. There is, as I have pointed out in my previous papers on this subject, some reason to believe that the change in colour in the equatorial belt of *Jupiter* is periodical. This belt of the planet at the time mentioned may have been of the same colour as during the last presentation,—that it was differently coloured during the presentation of 1868–9, is a fact attested by some six or seven, at least, well-known and skilful observers. It is true

* I am indebted to M. Gassiot for the opportunity of exhibiting the instrument on this occasion.

that in nearly every case these observers were using *reflectors*, of apertures varying between 6 and 12-inch, but I have heard from observers who have used achromatics varying between 4 and 8-inch, that they distinctly remarked the change in colour, although they do not seem to have seen it so plainly as those who have used reflectors. Unfortunately, none of these observers have published the results of their observations.

There is a singular agreement between observers who have described this phenomenon. The colour has been described as yellow, ochreish, brown, and tawny. All agree in ascribing this colour to the equatorial belt of the planet, ordinarily seen of a pure, or at most a pearly white.

The change has been one that might have been easily observed even by those who have not a quick eye for colour, by reason of the fact that the equatorial belt, which is ordinarily the brightest portion of the disk of the planet, and is so represented in every drawing I have ever seen of it, was, during the last presentation, much darker in colour than the bright belts nearer to the north and south poles of the planet.

Clapham, June 10th.

On the Proper Motion of Groombridge, 1830.

By W. T. Lynn, B.A.

In the year 1842 Professor Argelander announced* that he had detected that a star of the seventh magnitude on the boundaries of the constellations *Ursa Major* and *Canis Venatica* was animated by a Proper Motion considerably exceeding that known for any other star; amounting, in fact, annually to about 7″ of a great circle. This star had been observed by Groombridge, being numbered 1830 in his Catalogue of Circumpolar Stars, which was reduced to the epoch January 1, 1810, and edited by the Astronomer Royal, the date of publication being 1838. Having ascertained from Mr. Airy the exact times of Groombridge's observations, Argelander was able, the year after his discovery, to state† that the star's annual Proper Motion amounted to $+5''\cdot167$ in R.A. and $+5''\cdot70$ in N.P.D. This satisfied within the limits of probable error of observation all the other positions observed by Lalande, Bessel, Argelander, and Nicolai.

It occurred to me recently that, as a large number of very accurate observations of this star had been made at the Royal Observatory, Greenwich, since the year 1843, in which Professor Argelander made this determination, and that these observations extended now over more than a quarter of a century, it might be worth while to put them together, with the view of ascertaining whether the large Proper Motion in question continues uniform.

* *Astronomische Nachrichten*, No. 455. † Ibid. No. 475.

This comparison I now offer to the Society; remarking that, by the kind permission of the Astronomer Royal, I am enabled to include the result of the whole of the positions contained in the New Seven-year Catalogue of 2760 Stars, which is now passing through the press, and also that derived from the observations made last year, which are still in manuscript. In bringing back the observations to the 1st of January of the year which forms the epoch of each catalogue, the proportional part of the proper motion, as given by Argelander and copied into the British Association Catalogue, has been carefully applied. This had not indeed been done in the 12-year and 6-year Catalogues; but at the end of the 7-year Catalogue for 1860, published as an Appendix to the *Greenwich Observations* for 1862, will be found (pages {cxxi.} and {cxxiii.}) the positions which would have been given in those catalogues, had this been done.

Positions of *Groombridge*, 1830.

Epoch.	R.A.	No. of Obs.	N.P.D.	No. of Obs.	Authority.
	h m s		° ′ ″		
1845	11 44 1·53	13	51 10 10·90	16	12-year Catalogue.
1850	11 44 19·04	17	51 12 20·04	19	6-year Catalogue.
1860	11 44 53·91	18	51 16 37·44	8	7-year Cat. (1860).
1864	11 45 7·83	8	51 18 21·22	8	7-year Cat. (1864).
1869	11 45 25·24	2	51 20 29·84	2	Gr. Obs. 1869, MSS.

From this we obtain the following mean annual variations for the years comprised between each successive epoch:—

Years.	Ann. Var. in R.A.	Ann. Var. in N.P.D.
	s	″
1845–1850	+3·502	+25·83
1850–1860	3·487	25·74
1860–1864	3·480	25·94
1864–1869	+3·482	+25·72

If we subtract from each of these the annual precession, which in R.A. is $+3^{s}\cdot144$, and in N.P.D. $+20''\cdot01$, we find finally for the annual Proper Motion in each interval the following values:—

Years.	Proper Motion in R.A.	Proper Motion in N.P.D.
	s	″
1845–1850	+0·358	+5·82
1850–1860	0·343	5·73
1860–1864	0·336	5·93
1864–1869	+0·338	+5·71

The constancy, or nearly so, of the Proper Motion of this star, would seem, therefore, to be established.

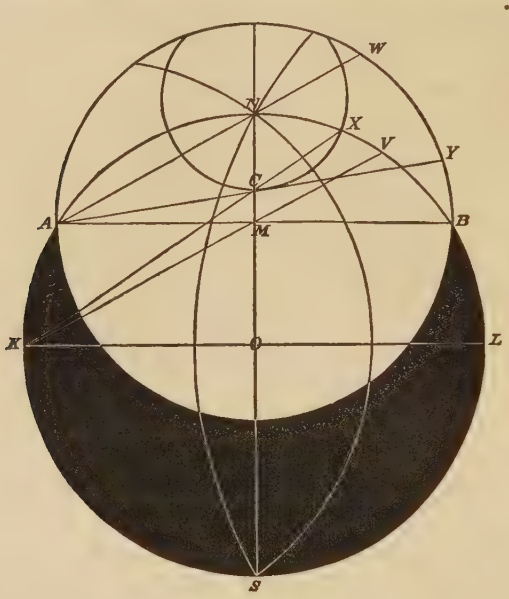
The Society have received from Mr. F. Abbott a communication, entitled "Some further Observations on the Variable Star η *Argûs* and the Surrounding Nebula," dated Hobart Town, Tasmania, 15th February, 1870, accompanied by a drawing of the nebula taken 28th January, 1870. He refers to his former drawings, 1863, *Monthly Notices*, vol. xxiv. p. v., and 1868, ditto, vol. xxviii. p. 200, and to the *Cape Monograph*, and remarks that the alterations which have taken place in the nebula since 1868 will be at once seen on an inspection of the drawings and by comparing them with each other. In the *Cape Monograph* the dark space is an inclosure. In 1863 it had two openings, one at each end. In 1868 there were four openings, and now in 1870 there are five, exposing a number of isolated and distinct stars, which render it difficult but from position to know which is the star η *Argûs*. There is attendant on these changes an increase of light which is notable up to the present time.

On a Property of the Stereographic Projection.

By Prof. Cayley.

I am not aware whether it has been noticed that the very same circles which in the direct stereographic projection of a hemisphere (viz., that wherein the projection is on the plane of a meridian) represent the meridians and parallels respectively, —represent also in the oblique projection of the hemisphere meridians and parallels respectively. In fact, in the direct projection where the poles N, S, are in the horizon-meridian, or bounding circle of the projection, if we take a chord A B at right angles to N S, and on A B as diameter describe a circle, the original (meridian and parallel) circles will, as the appearance of the figure at once suggests, represent meridians and parallels in the oblique projection in which the horizon or bounding circle of the projection is the circle diameter A B, and where consequently the North Pole N is brought into view, the South Pole S being beyond the limits of the projection. That this really is so, is clear from the consideration that in any stereographic projection whatever, the meridians will be circles passing through two fixed points N, S, and the parallels be circles cutting the meridians at right angles. (Or, what is the same thing, the parallels also pass each of them through two fixed imaginary points, the antipoints of N, S, but this in passing.) And, moreover, since in the oblique, as well as in the direct projection, the longitude of any meridian, as reckoned from the central meridian N S, is the angle at N between the two meridians, the longitude for a given meridian is the same in the two projections respectively. But the co-latitudes are not the same in the two projections respectively; viz., a circle which in the

direct projection represents the parallel co-latitude c, will in the oblique projection represent the parallel of a different co-latitude



c'. The relation between the values of c, c', will of course depend upon the position of the bounding circle A B of the oblique direction: to define this position, we may use either the arc N M which in the direct projection determines the co-latitude of the centre M of the oblique projection (say N M $= \Delta$, that is, N V $= \Delta$), or by the arc N M which in the oblique projection determines the distance of N from the centre, or co-latitude of the centre (say N M $= \Delta'$, that is, B W $= \Delta'$.) The obliquity in the oblique projection is thus $90° - \Delta'$, viz., this is the inclination of the plane of projection to that of the horizon-meridian in the direct projection. We have also $c =$ N X, $c' =$ W Y. The relation between the angles Δ, Δ', is easily found to be

$$\tan \tfrac{1}{2} \Delta = \tan^2 \tfrac{1}{2} \Delta',$$

viz., taking the radius in the direct projection to be $= 1$, we have

$$\text{O M} = \tan \tfrac{1}{2} (90° - \Delta),$$

$$\text{M A} = \sqrt{1 - \tan^2 \tfrac{1}{2} (90° - \Delta)},$$

$$\text{M N} = 1 - \tan \tfrac{1}{2} (90° - \Delta);$$

wherefore

$$\sqrt{1 - \tan^2 \tfrac{1}{2} (90° - \Delta)} \cdot \tan \tfrac{1}{2} \Delta' = 1 - \tan \tfrac{1}{2} (90° - \Delta).$$

and thence

$$\tan^2 \tfrac{1}{2} \Delta' = \frac{1 - \tan \tfrac{1}{2} (90^\circ - \Delta)}{1 + \tan \tfrac{1}{2} (90^\circ - \Delta)} = \tan \tfrac{1}{2} \Delta,$$

the required relation.

We have moreover

$$\begin{aligned} \mathrm{N\,C} = 1 - \tan \tfrac{1}{2} (90^\circ - c) &= \mathrm{A\,M} \left\{ \tan \tfrac{1}{2} \Delta' - \tan \tfrac{1}{2} (\Delta' - c') \right\} \\ &= \sin \Delta' \left\{ \tan \tfrac{1}{2} \Delta' - \tan \tfrac{1}{2} (\Delta' - c') \right\} \\ &= 2 \sin^2 \tfrac{1}{2} \Delta' - \sin \Delta' \tan \tfrac{1}{2} (\Delta' - c'), \end{aligned}$$

that is

$$\begin{aligned} \tan \tfrac{1}{2} (90^\circ - c) &= \cos \Delta' + \sin \Delta' \tan \tfrac{1}{2} (\Delta' - c') \\ &= \frac{\cos \tfrac{1}{2} (\Delta' + c')}{\cos \tfrac{1}{2} (\Delta' - c')}, \end{aligned}$$

or, what is the same thing,

$$\frac{1 - \tan \tfrac{1}{2} c}{1 + \tan \tfrac{1}{2} c} = \frac{1 + \tan \tfrac{1}{2} c' \tan \tfrac{1}{2} \Delta'}{1 + \tan \tfrac{1}{2} c' \tan \tfrac{1}{2} \Delta'},$$

that is

$$\tan \tfrac{1}{2} c = \tan \tfrac{1}{2} \Delta' \tan \tfrac{1}{2} c',$$

which is the required relation between c and c'. In the particular case $\Delta = \Delta' = 90^\circ$, the two projections coincide, and we have, as we should do, $c' = c$.

Note respecting Solar Spots visible to the Naked Eye.

By A. R. Hill, Sub. Lieut. R.N.

On Sunday, 22d May, at from about 5 to 6.30 P.M., the extreme light of the Sun being obscured by a peculiar scud drifting over it, and giving the whole disk a reddish appearance, with the borders less luminous than the centre, I observed three large spots, A, B, and C, as in diagram, fig. 1, distinctly visible with the naked eye, especially A and B, A being the most distinct, and C being only visible at times, when the ardour of the Sun's rays was diminished more than at others.

On Monday, 23d, at about the same time P.M., the atmosphere being still in the same state as on the previous day, but more advantageous for naked-eye observations, I observed the spots, A, B, and C again, C being more distinct than on the previous evening; and also another spot, D, fig. 2.; but this latter being only visible at the most advantageous intervals.

During these two days the barometer averaged about 30·20 in. and thermometer, Fahrenheit, 66° in the shade at the times of observation.

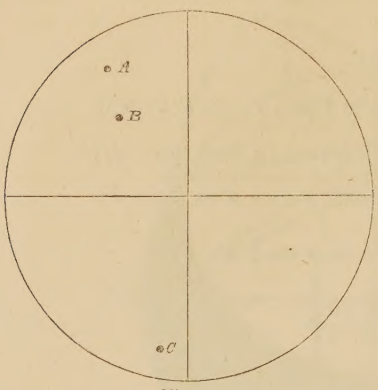


Fig. 1.

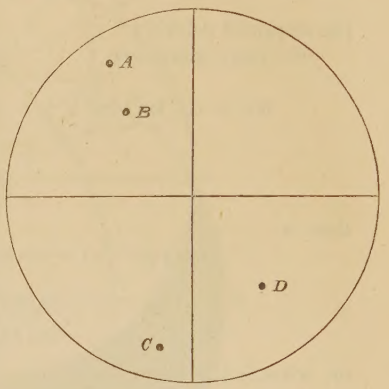


Fig. 2.

Norton, Presteign, Radnorshire, May 30th, 1870.

Winnecke's New Comet.

(*Extract of a Letter from Dr. Winnecke to Mr. Hind, dated Carlsruhe, May* 31.)

"You have probably received through the Vienna Academy the news of a small comet discovered by me in the night, May 29–30, in *Pisces*.

"I can send you to-day the following observations:

			Comet – Star.	
May 29	$14^h\ 12^m\ 38^s$ M.T. Carlsruhe	$\Delta\alpha = +0^m\ 13^s\cdot55$	8 Comp.
	$14\ 13\ 22$,,	$\Delta\delta = +0'\cdot\ 9''\cdot9$	5 Comp.

The star of comparison is only to be found in the *Bonner Durchmg.* 9.3, 1855·0.

$$\alpha = 0^h\ 47^m\ 55^s\cdot9 \qquad \delta = +29°\ 1'\cdot5$$

The last night was very cloudy, so that I have got but 3 comp. with a star twice observed by Argelander, *Bonn. Beob.* VI. + 28° No. 159.

M.T. Carls.	Comet's R.A.	Comet's Decl.
May 30 $14^h\ 13^m\ 34^s$	$= 0^h\ 50^m\ 9^s\cdot55$	$= +28°\ 52'\ 18''$

The comet is a round, pretty bright nebula, of about $2\frac{1}{2}$ minutes in diameter"

Elements and Ephemeris of Winnecke's New Comet.

(*Communicated in a Letter from Dr. Winnecke to Mr. Hind.*)

The elements, which depend upon observations at Carlsruhe to June 2, and one made by Prof. Argelander on June 5, are as follow :—

T = 1870, July 12·905, M.T. at Berlin.

$$\left.\begin{aligned} \pi &= 302\ 14\ 53 \\ \Omega &= 140\ 3\ 45 \end{aligned}\right\} \text{Apparent Equin. June 2.}$$

$$i = 57\ 19\ 17$$

$$\log q = 9{\cdot}99579$$

Retrograde.

Ephemeris for 12^h, Berlin.

1870.	R.A.	δ	Log r.	Log Δ.
	° ′	° ′		
May 30	12 30·7	+28 53·8	0·0910	0·2078
June 3	13 42·7	27 51·0	0·0775	0·1779
7	15 0·6	26 37·2	0·0643	0·1445
11	16 26·9	25 8·9	0·0517	0·1070
15	18 4·4	23 21·0	0·0398	0·0649
19	19 58·1	21 6·6	0·0289	0·0173
23	22 14·9	18 14·4	0·0192	9·9632
27	25 5·3	14 27·2	0·0109	9·9018
July 1	28 46·5	9 16·1	0·0042	9·8328
5	33 45·7	+ 1 59·0	9·9994	9·7571

Observations of Winnecke's New Comet. By S. J. Perry, Esq.

The comet discovered on May 30, at Carlsruhe, by Dr. Winnecke, was observed here on June 6, at about 12^h 30^m G.M.T. Its brilliancy must be considerably greater than that of the comet found last year by the same astronomer. Since it was picked up almost immediately with a low power, although the light of both Sun and Moon were sufficiently strong to illumine the field distinctly, and the object was not many degrees from the eastern horizon.

The co-ordinates corrected for instrumental errors and refraction were on June 6, at 17^h 45^m 38^s·5 sidereal time.

R.A. 0^h 57^m 3^s·6 N.P.D. 62° 49′ 31·6

Light clouds prevented my obtaining a position of June 7, and last night the sky was completely obscured by clouds. I hope to observe it again when the Moon rises after midnight. I have several times swept in vain for D'Arrest's comet.

June 8, 1870,
Stonyhurst Observatory, Whalley.

Instrument for Sale.

A Dip Sector or Dipping Needle, German make, in a handsome case, quite new, never having been used, provided with a mirror, by which the deviations of the magnetic needle are indicated with the greatest possible accuracy. For further particulars apply to the Assistant-Secretary at the Rooms of the Society.

ERRATA.

Page 176, line 2 from bottom, *for* "richly" *read* "sickly."

Page 179, line 8 from bottom, *for* Feb. 2, *read* Feb. 10.

,, line 7 from bottom, *for* $9^h\ 7^m\ 14^s{\cdot}9$, G.M.T., *read* $9^h\ 8^m\ 10^s$, G.M.T.

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Printed by STRANGEWAYS AND WALDEN, Castle Street, Leicester Square, and Published at the Apartments of the Society, June 27, 1870.